Tutorial
H-1000-5336-01-C

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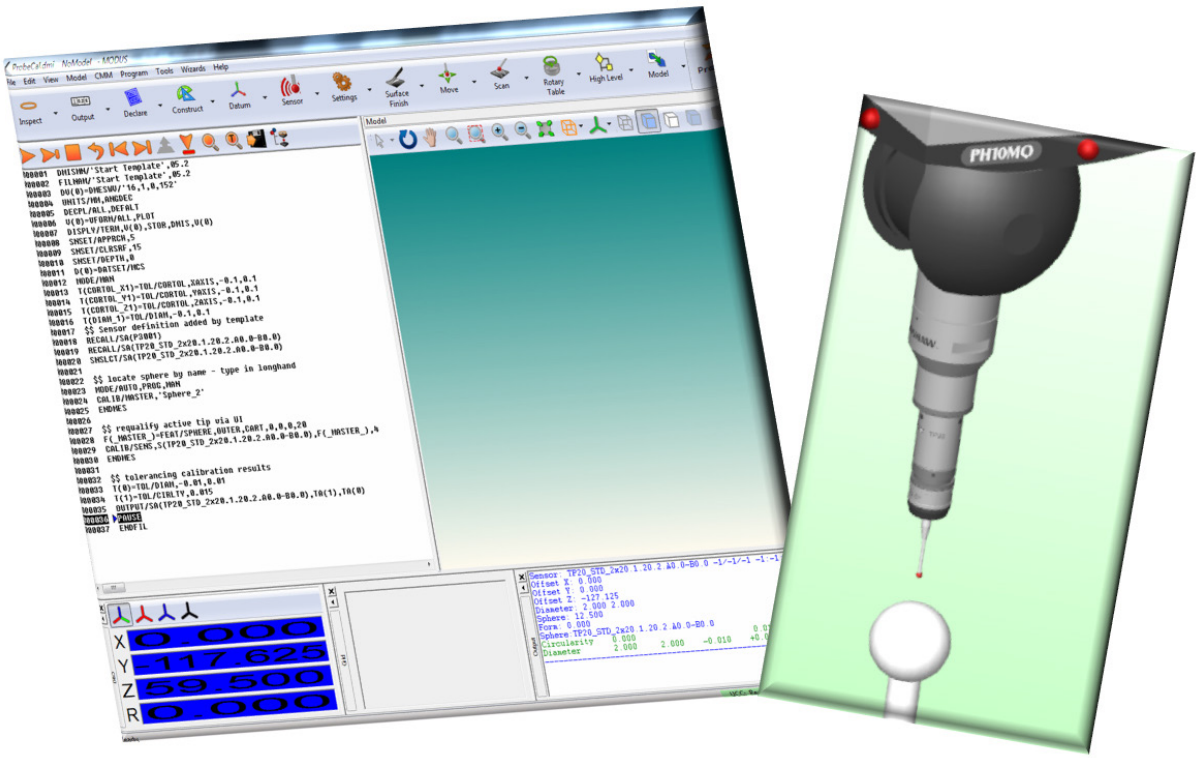
Calibration and sphere location in MODUS



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Calibration and sphere location in MODUS

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1 Calibration and sphere location in MODUS

1.1 Tutorial pre-requisites

- The student should have completed all of the basic tutorials
- The student should have completed the ‘Introduction to high level programming’ tutorial and have a sound understanding of the use of variables.

1.2 Tutorial objectives

- Introducing the student to the concept of using only one software package to create self-contained measurement and output programs
- Introducing the student to the quantification and control of calibration quality

2 Introduction

This tutorial covers location of calibration spheres, calibration of tools and the obtaining and tolerancing of calibration results from within MODUS software. It is more convenient to do this through MODUS rather than UCCserver because it keeps all operations within a single program.

3 Locating a calibration sphere using DMIS

Set up the required tools and calibration spheres in a UCCserver environment. Do not calibrate any tools or locate the calibration spheres though.

Create a new MODUS program using the default template.

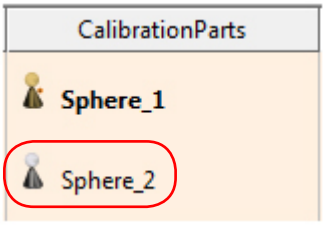
The code for locating the calibration sphere must be added manually into the part program, since there is no button or drop down menu for inserting this code.

Insert a new line (CTRL + I) in the MODUS program and add appropriate code to match the calibration sphere in the UCCserver environment.

Example code:

CALIB/MASTER, 'Sphere_2'

GUIDANCE NOTE: The code 'Sphere_2' is the name of the calibration sphere used in this tutorial. Be sure to change this code to match the actual calibration sphere name. If the sphere name is not specified, the default sphere is used.



Example code:

```
000018
000019  SNSLCT/SA(TP20_STD_2X20.1.20.2.A0.0-B0.0)
000020
000021  $$  locate sphere by name - type in longhand
000022  MODE/AUTO,PROG,MAN
000023  CALIB/MASTER,'sphere_2'
000024  ENDMES
000025
000026
```

The program mode has been changed to AUTO.

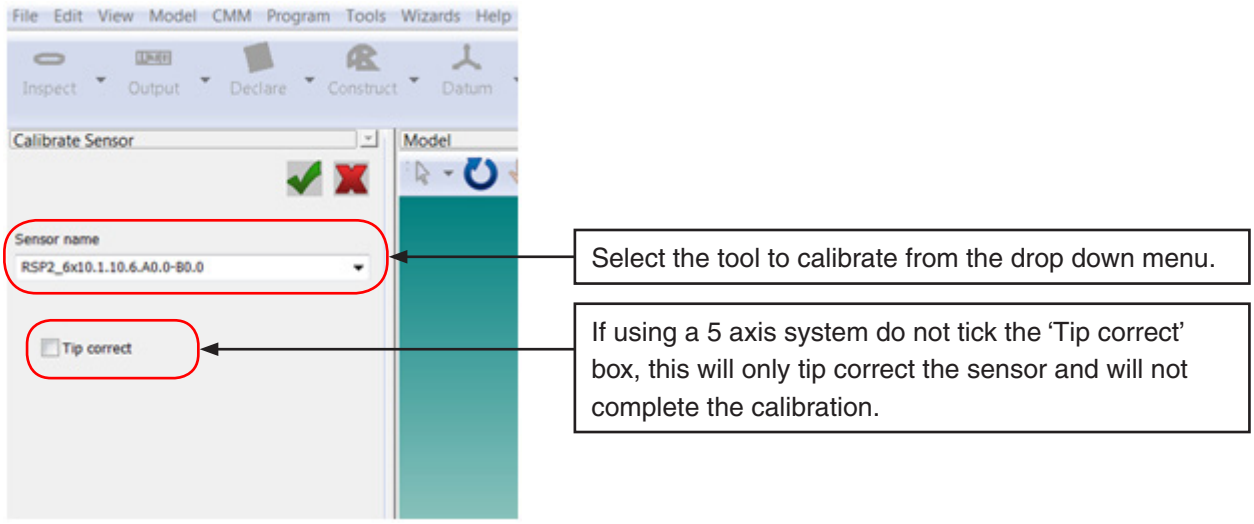
Location code.

An ENDMES to end the measurement block.

Before running the code above, place the tool centrally above the sphere. Run the code and the 'Locate' routine will be completed, this will update the position of the sphere.

4 Calibration of tools using DMIS

Calibration of the tool is achieved by using the user interface. Click on 'Sensor' and then select 'Requalify'.



Example code:

```
000018
000019  SNSLCT/SA(TP20_STD_2X20.1.20.2.A0.0-B0.0)
000020
000021  $$  locate sphere by name - type in longhand
000022  MODE/AUTO,PROG,MAN
000023  CALIB/MASTER,'sphere_2'
000024  ENDMES
000025
000026  $$  requalify active tip via UI
000027  F(_MASTER_)=FEAT/SPHERE,OUTER,CART,0,0,0,20
000028  CALIB/SENS,S(TP20_STD_2X20.1.20.2.A0.0-B0.0),F(_MASTER_),4
000029  ENDMES
000030
```

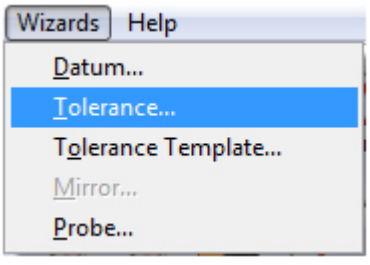
Code generated.

The tool will then go through its calibration routine using the located sphere.

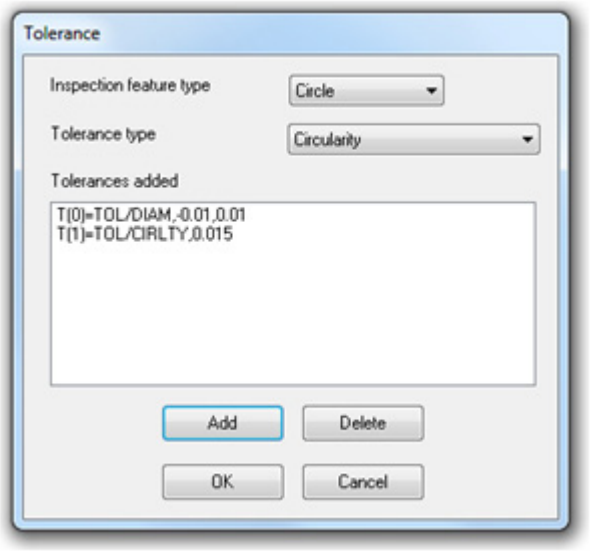
4.1 Tolerancing calibration results

It is sometimes necessary to check the calibration results to a tolerance, to verify that the calibration is accurate.

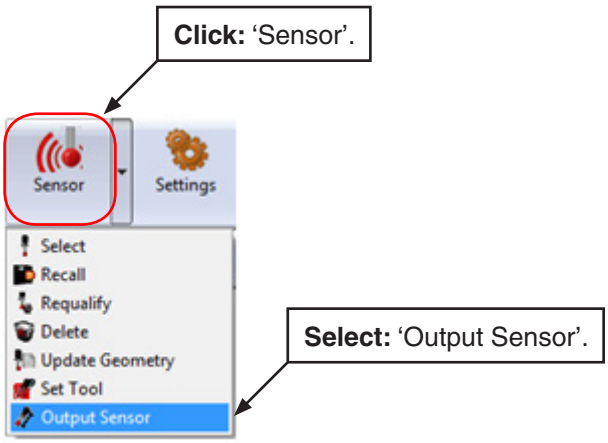
First, create a diameter and form tolerance from the 'Tolerance' wizard.



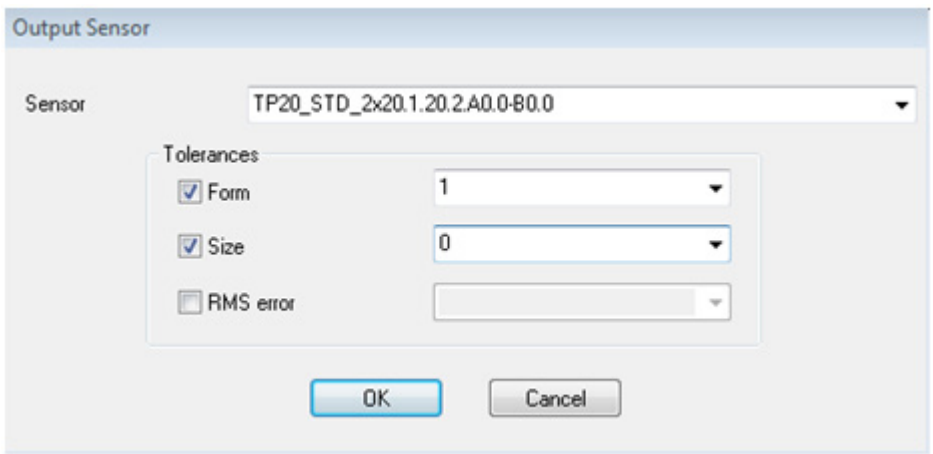
Use a ‘Circle’ as the ‘Inspection feature type’, since the tolerance wizard does not allow the use of a ‘Circularity Tolerance type’ if a sphere is selected.



Finally, the sensor data can be output.



Enter the appropriate values in the dialog box.



Example code:

```
$$ tolerancing calibration results
T(0)=TOL/DIAM,-0.01,0.01
T(1)=TOL/CIRLTY,0.015
OUTPUT/SA(TP20_STD_2x20.1.20.2.A0.0-B0.0),TA(1),TA(0)
```

Example output:

```
Sensor: TP20_STD_2x20.1.20.2.A0.0-B0.0 -1/-1/-1 -1:-1:-1
Offset X: 0.000
Offset Y: 0.000
Offset Z: -127.125
Diameter: 2.000 2.000
Sphere: 12.500
Form: 0.000
Sphere:TP20_STD_2x20.1.20.2.A0.0-B0.0
Circularity    0.000                    0.015          *---
Diameter      2.000    2.000    -0.010    +0.010    0.000 ---*---
```

5 Obtaining and tolerancing calibration results

5.1 Alternative method of obtaining and tolerancing calibration results using variables

Declare two variables (as shown in previous tutorial), one for form and one for diameter.

Example code:

```
000031  DECPL/ALL,5
000032  DECL/LOCAL,DOUBLE,L_DBL_FORM
000033  DECL/LOCAL,DOUBLE,L_DBL_DIAM
000034  _
```

Set the amount of decimal places required for the data needed.

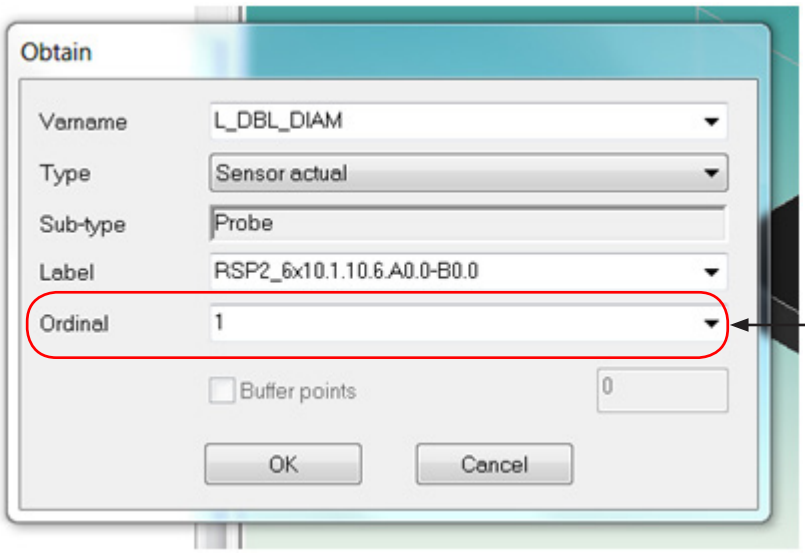
Click: 'Settings' then select 'Decimal Places'.

Acquire calibration results for 'Form' and 'Diameter' using the 'Obtain' command (as shown in previous tutorial).

GUIDANCE NOTE: For the correct ordinals to use, refer to MODUS help (F1 - Ordinals in high level programming).

Ordinals for actual sensors

Ordinal	Feature	Variable type
1	Offset	Character
2	Tip x offset	Double
3	Tip y offset	Double
4	Tip z offset	Double
5	Effective diameter	Double
6	Sphere size - this option is not currently available	Double
7	Form	Double
8	Sphere name	Character
9	Sphere location x	Double
10	Sphere location y	Double
11	Sphere location z	Double
12	Date and time of calibration	Character



Example code:

```
000035  $$  OBTAIN CALIBRATION RESULTS
000036  L_DBL_DIAM=OBTAIN/SA(TP20_STD_2X20.1.20.2.A0.0-B0.0),5
000037  L_DBL_FORM=OBTAIN/SA(TP20_STD_2X20.1.20.2.A0.0-B0.0),7
```

The code for tolerancing the features must be added manually into the part program. The nominal value must be explicitly defined, as well as using the variable as the actual value in the part program.

An object is normally used to store non-measured data (e.g. temperature). In this instance, it will be used to store calibration data so that tolerances can be applied later. First create an object to store the obtained variable, where CAL_DIAM and CAL_FORM are the place holders.

```
000039  $$  CREATE OBJECT TO STORE VARIABLE
000040  F(CAL_DIAM)=FEAT/OBJECT,DBLVAL,2.00000
000041  FA(CAL_DIAM)=FEAT/OBJECT,DBLVAL,L_DBL_DIAM
000042
000043  F(CAL_FORM)=FEAT/OBJECT,DBLVAL,0.00000
000044  FA(CAL_FORM)=FEAT/OBJECT,DBLVAL,L_DBL_FORM
000045
```

Feature nominal.

Feature actual (variable).

Then the object needs to be toleranced using the ‘USETOL’ command and output.

```
000046  $$  TOLERANCE USING USETOL
000047  T(CAL_DIA_TOL)=TOL/USETOL,DBLVAL,-0.01,0.01
000048  OUTPUT/FA(CAL_DIAM),TA(CAL_DIA_TOL)
000049
000050  T(CAL_FORM_TOL)=TOL/USETOL,DBLVAL,0,0.01
000051  OUTPUT/FA(CAL_FORM),TA(CAL_FORM_TOL)
```

Tolerance values.

Created object.

This will then output the ‘Form’ and ‘Diameter’ using the specified tolerance.

Example of completed program code:

```
000019  SNSLCT/SA(TP20_STD_2X20.1.20.2.A0.0-B0.0)
000020
000021  $$  locate sphere by name - type in longhand
000022  MODE/AUTO,PROG,MAN
000023  CALIB/MASTER,'sphere_2'
000024  ENDMES
000025
000026  $$  requalify active tip via UI
000027  F(_MASTER_)=FEAT/SPHERE,OUTER,CART,0,0,0,20
000028  CALIB/SENS,S(TP20_STD_2X20.1.20.2.A0.0-B0.0),F(_MASTER_),4
000029  ENDMES
000030
000031  DECPL/ALL,5
000032  DECL/LOCAL,DOUBLE,L_DBL_FORM
000033  DECL/LOCAL,DOUBLE,L_DBL_DIAM
000034
000035  $$  OBTAIN CALIBRATION RESULTS
000036  L_DBL_DIAM=OBTAIN/SA(TP20_STD_2X20.1.20.2.A0.0-B0.0),5
000037  L_DBL_FORM=OBTAIN/SA(TP20_STD_2X20.1.20.2.A0.0-B0.0),7
000038
000039  $$  CREATE OBJECT TO STORE VARIABLE
000040  F(CAL_DIAM)=FEAT/OBJECT,DBLVAL,2.00000
000041  FA(CAL_DIAM)=FEAT/OBJECT,DBLVAL,L_DBL_DIAM
000042
000043  F(CAL_FORM)=FEAT/OBJECT,DBLVAL,0.00000
000044  FA(CAL_FORM)=FEAT/OBJECT,DBLVAL,L_DBL_FORM
000045
000046  $$  TOLERANCE USING USETOL
000047  T(CAL_DIA_TOL)=TOL/USETOL,DBLVAL,-0.01,0.01
000048  OUTPUT/FA(CAL_DIAM),TA(CAL_DIA_TOL)
000049
000050  T(CAL_FORM_TOL)=TOL/USETOL,DBLVAL,0,0.01
000051  OUTPUT/FA(CAL_FORM),TA(CAL_FORM_TOL)
```

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Renishaw plc

New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com

www.renishaw.com

RENISHAW
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For worldwide contact details, please visit our main web site at www.renishaw.com/contact

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